Barcelona Supercomputing Center
Centro Nacional de Supercomputación

EXCELENCIA SEVERO OCHOA

Development of sea ice forecast errors in a seasonal forecast system with EC-Earth

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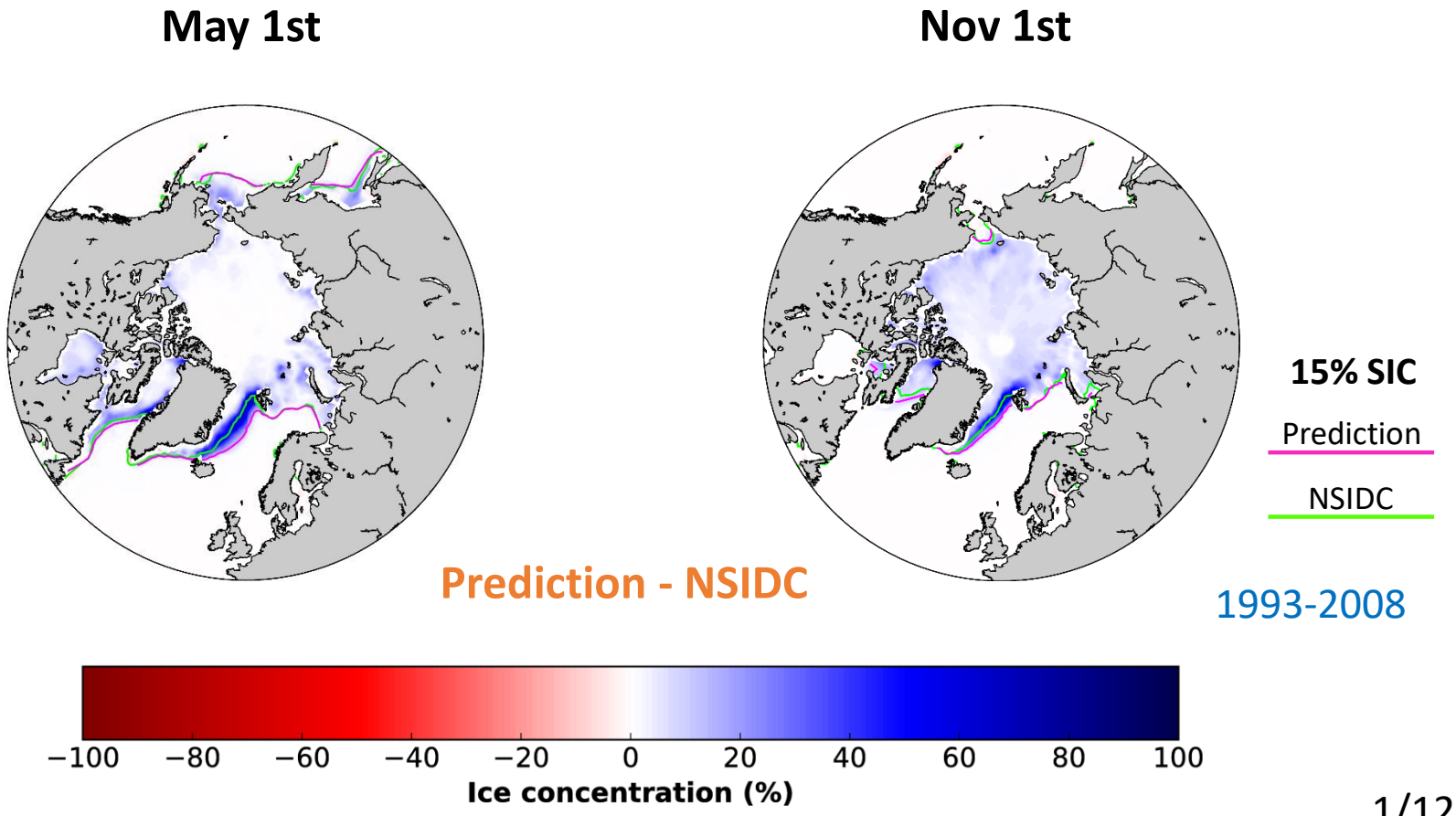
29th/Jan/2019

APPLICATE GA 2019, Reading.

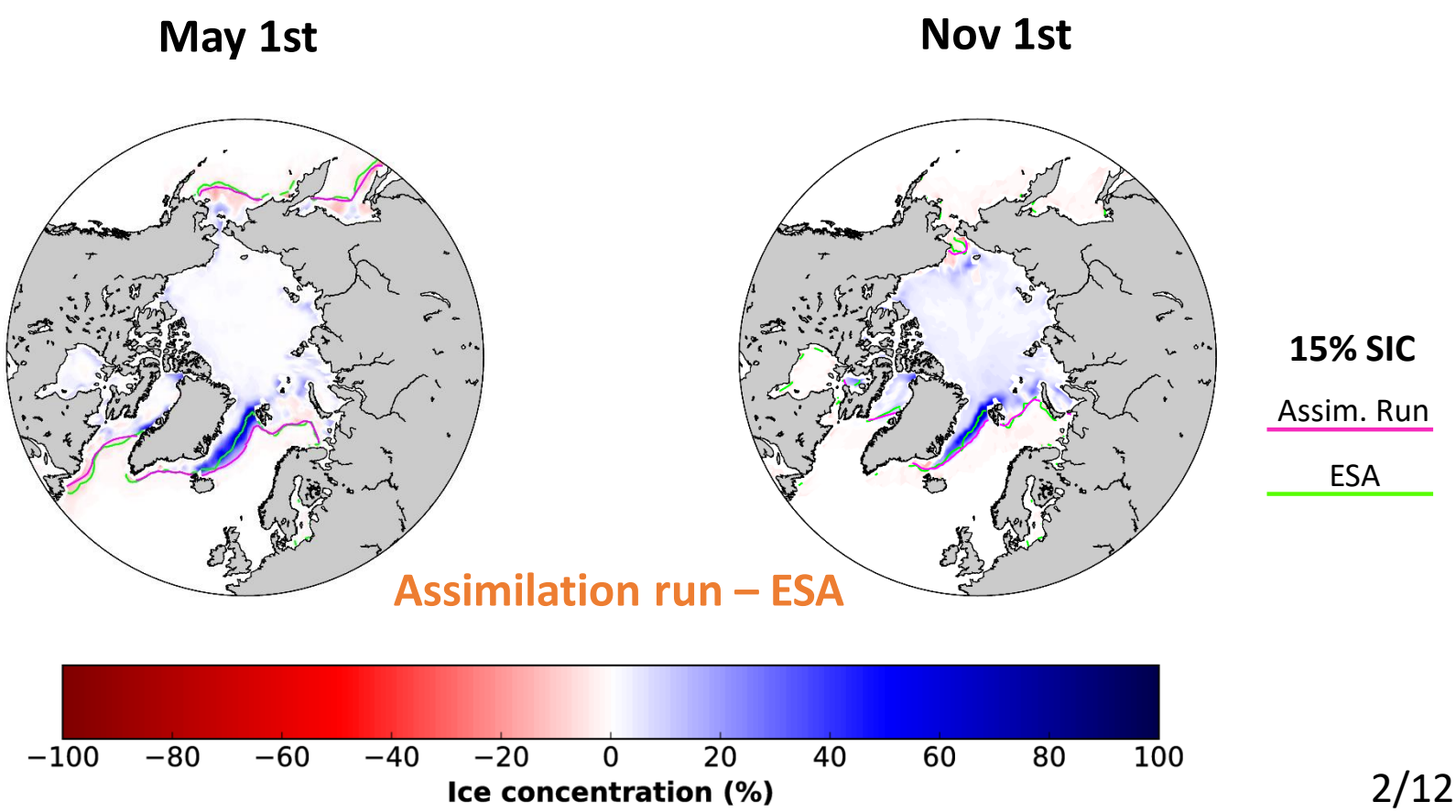
1. Motivation

- Large SIC bias from the first prediction day (vs NSIDC):



2.1 Limitations in the assimilation procedure

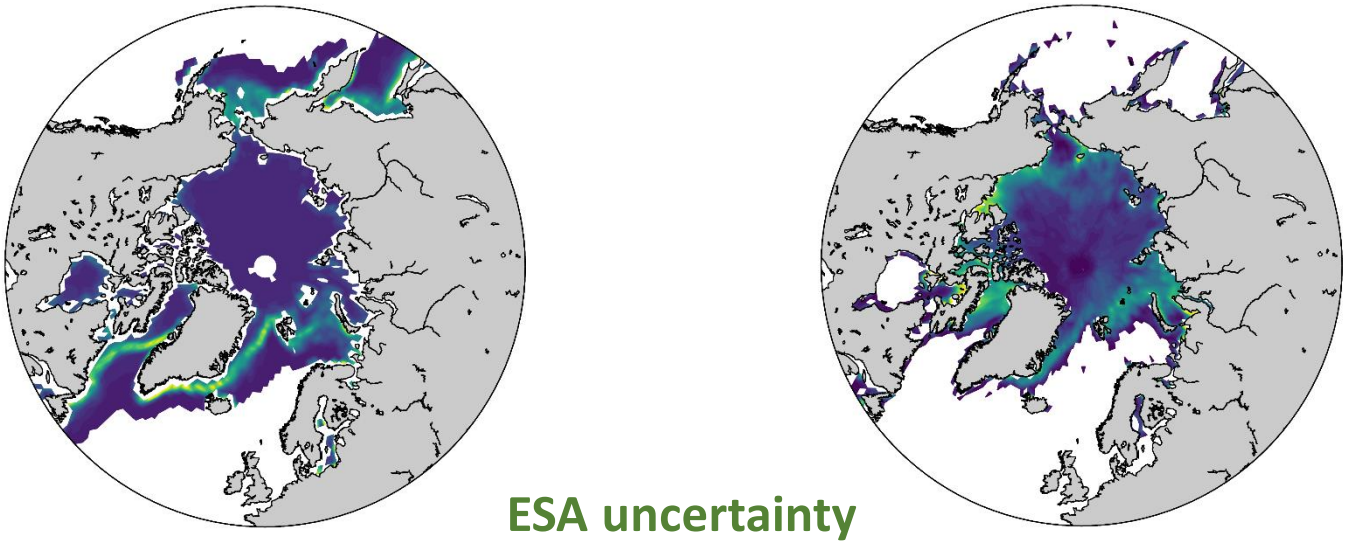
- The sea ice initial conditions (EnKF reconstruction) do not assimilate the target observations (ESA) adequately:



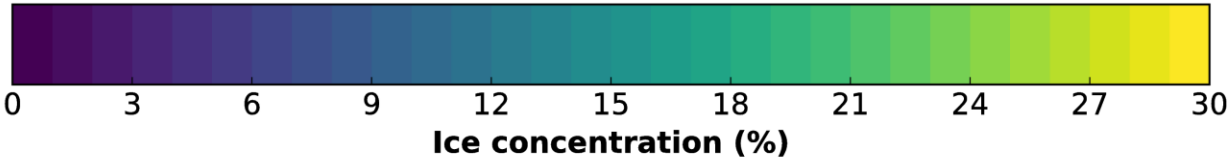
2.1 Limitations in the assimilation procedure

- The locations where assimilation does not work properly match the places with large observational uncertainty.

May 1st **Nov 1st**



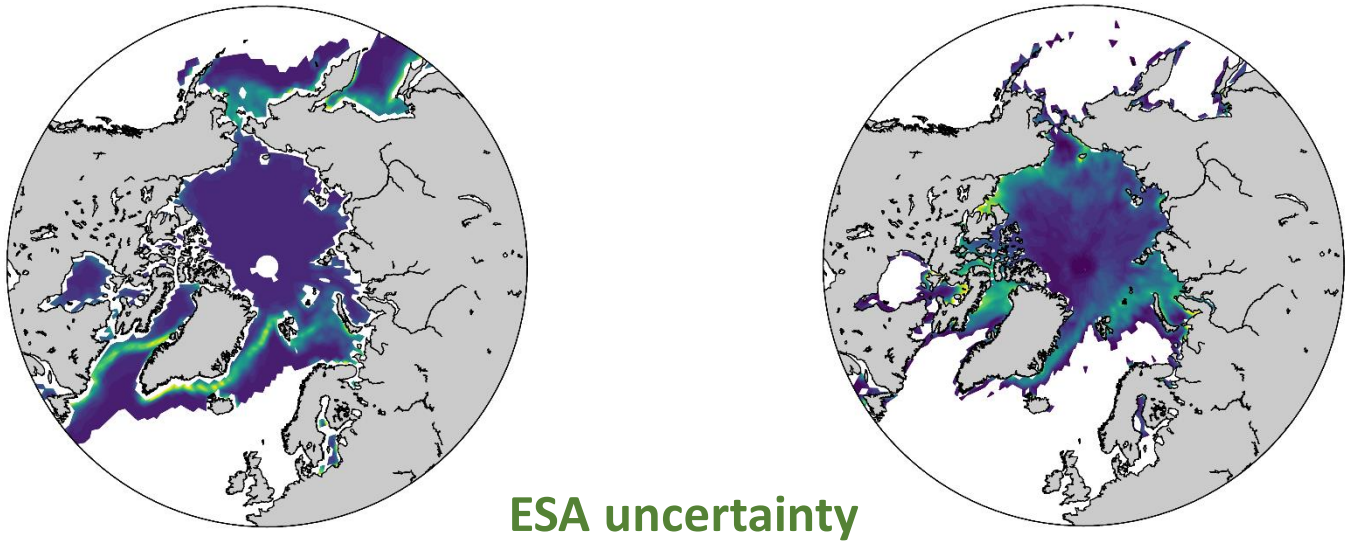
ESA uncertainty



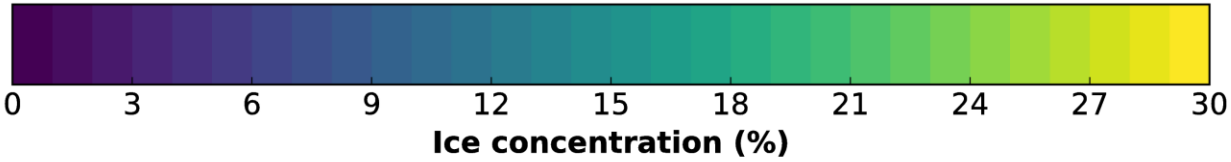
2.1 Limitations in the assimilation procedure

Given the large magnitude of this error, the rest of the errors will be quantified relative to the initial conditions (assimilation run).

May 1st **Nov 1st**



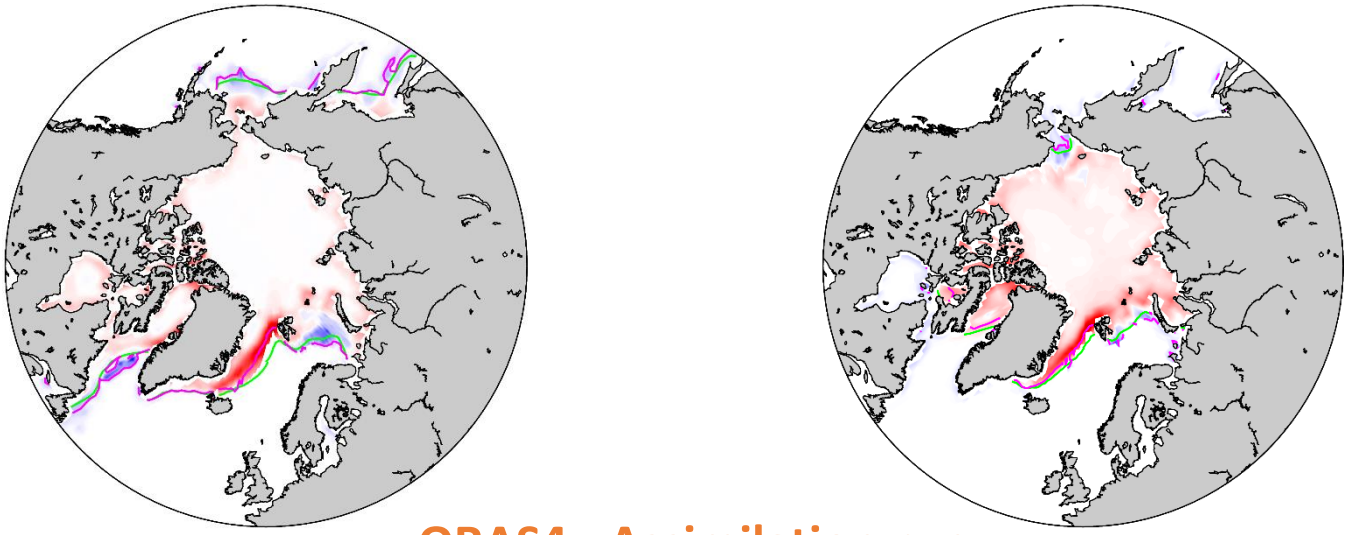
ESA uncertainty



2.2 Inconsistency between the initialization products

- Incompatibility between the sea ice of ORAS4 (ocean ICs) and the sea ice in the assimilation run (sea ice ICs).

May 1st **Nov 1st**

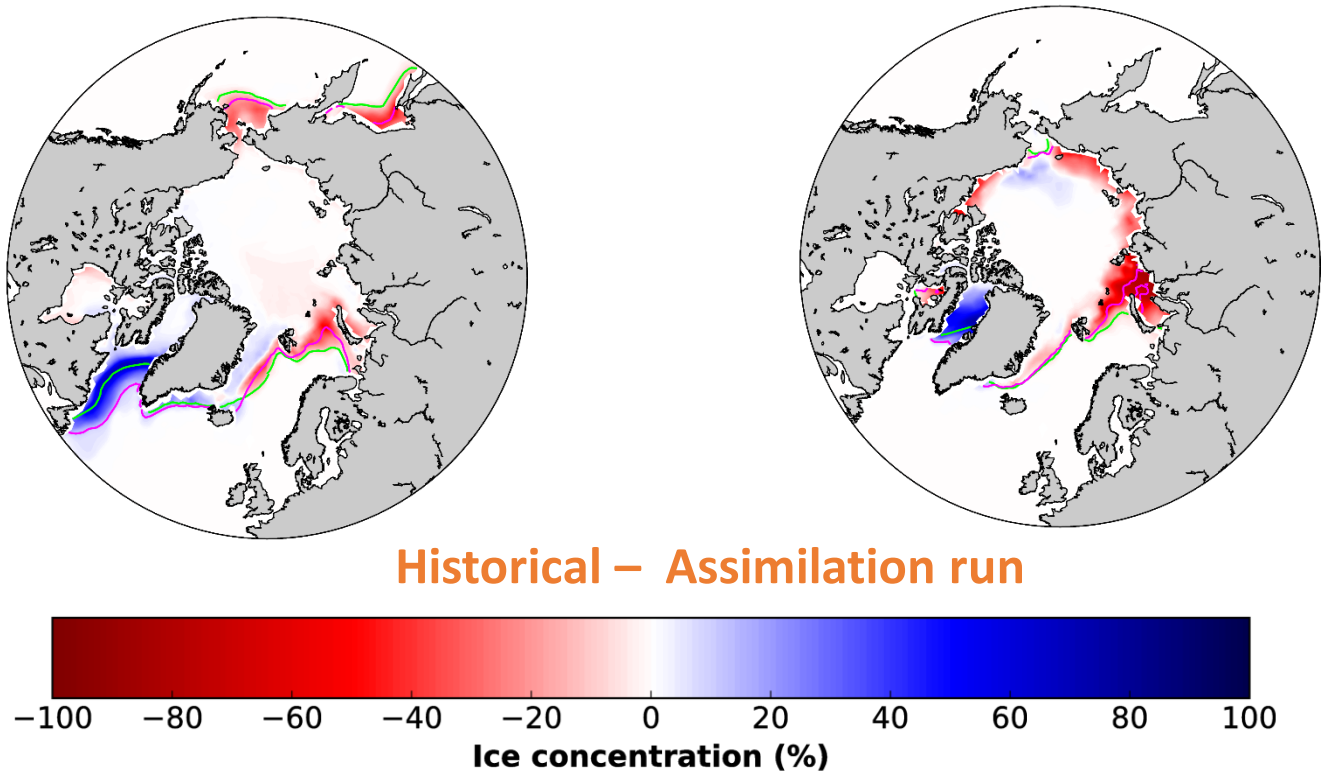


Thanks to M. Balmaseda for the ORAS4 sea ice data

2.3 Model drift

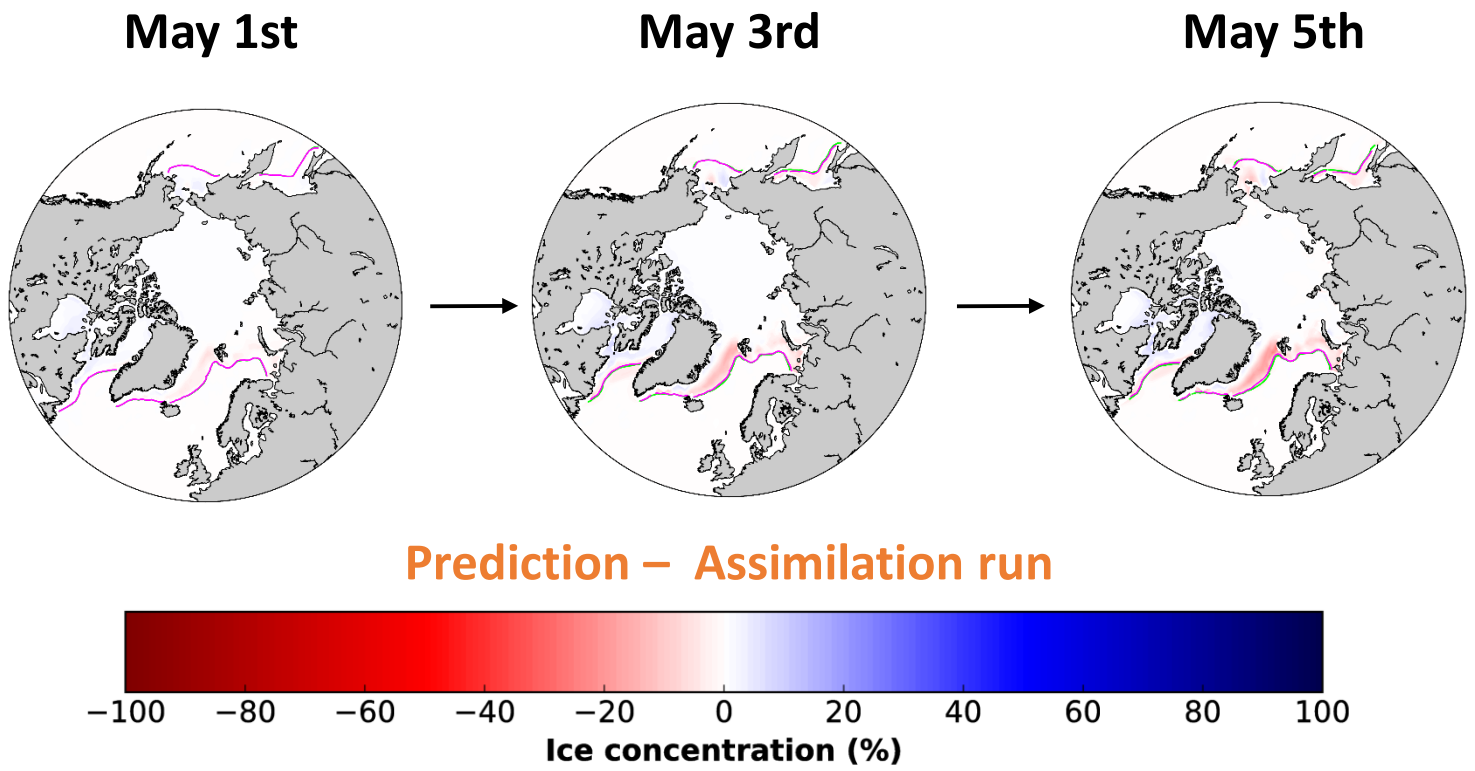
- The analysis of the historical (and therefore uninitialized predictions) allows us to determine the systematic model bias.

May 1st **Nov 1st**



2.4 Impact in the forecasts

- We expect a fast response in the forecasts in which the warmer ocean below degrades the overly extensive sea ice conditions from the assimilation.



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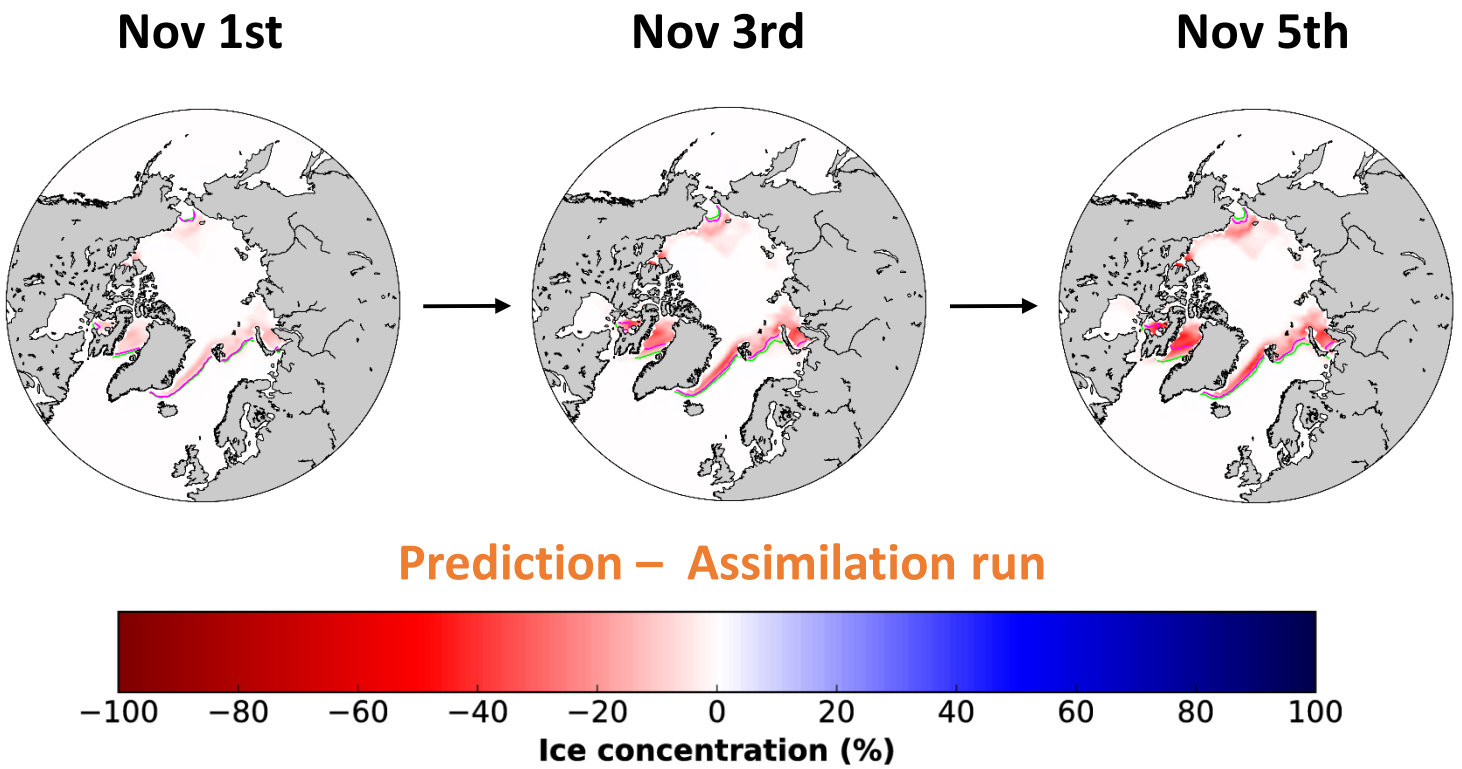
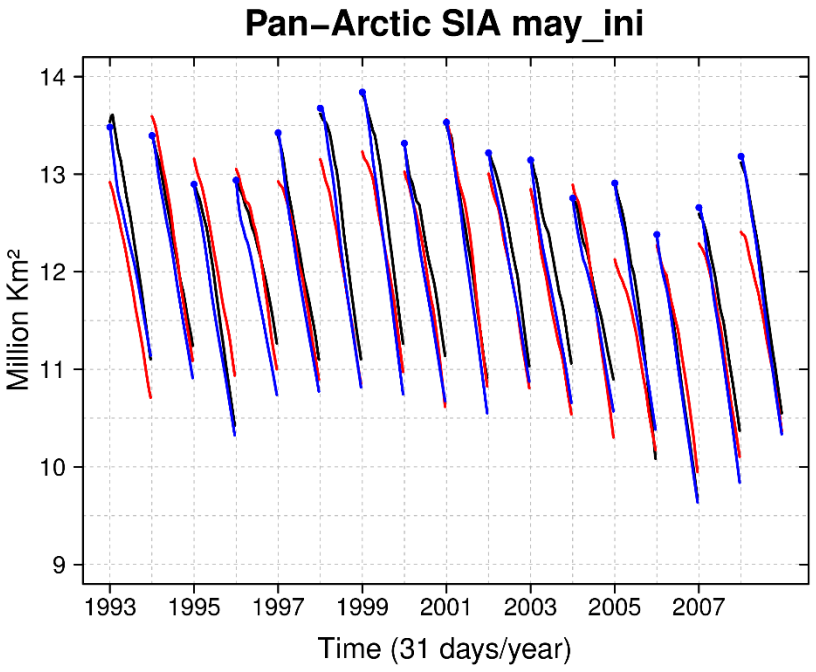
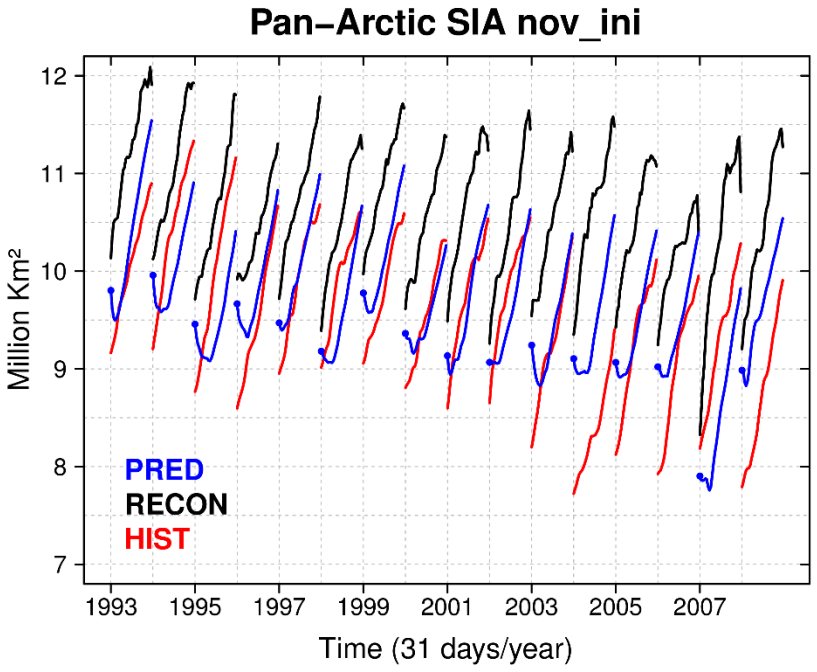


3. Understanding how model errors develop

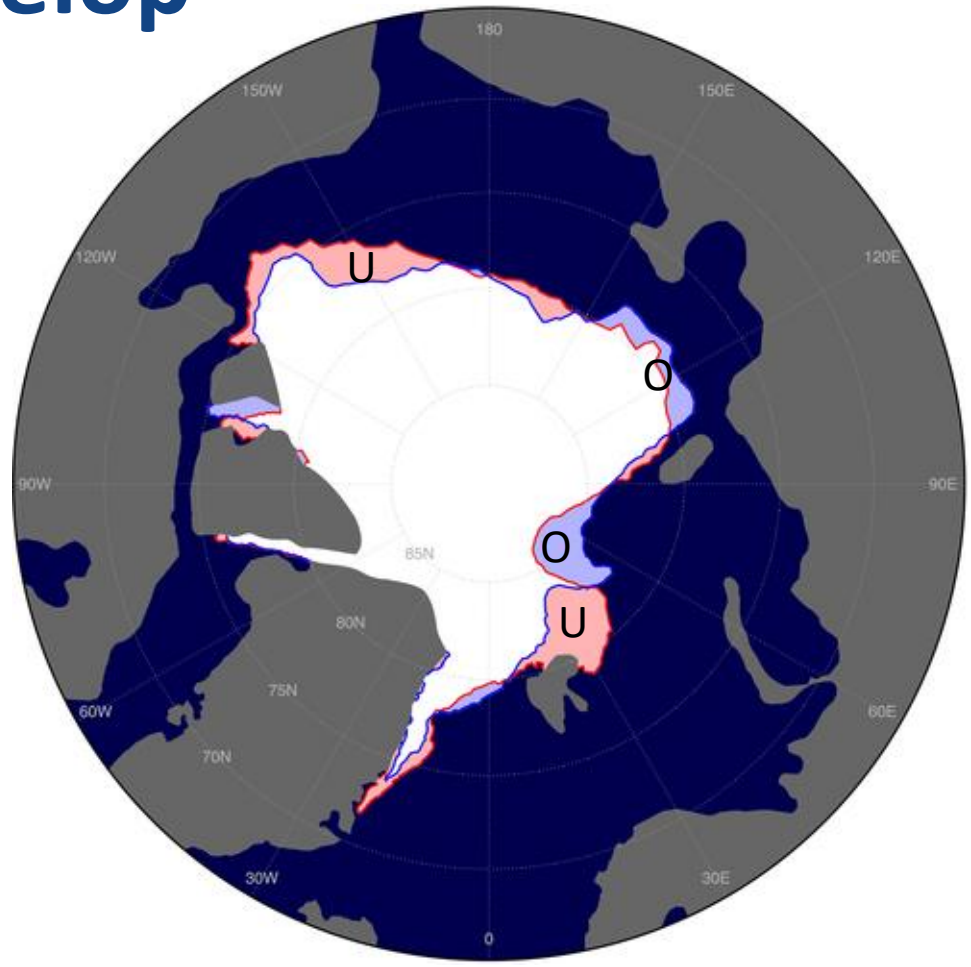
- The forecasts drift towards their model attractor in ~1 week.
- The shrinking (growing) trend in May (November) favours (hampers) the *absorption* of the initialization shock.





3. Understanding how model errors develop

- Integrated Ice Edge Error (IIEE) → The area where forecast and truth disagree on the sea ice concentration being above or below 15%.



IIEE = O + U

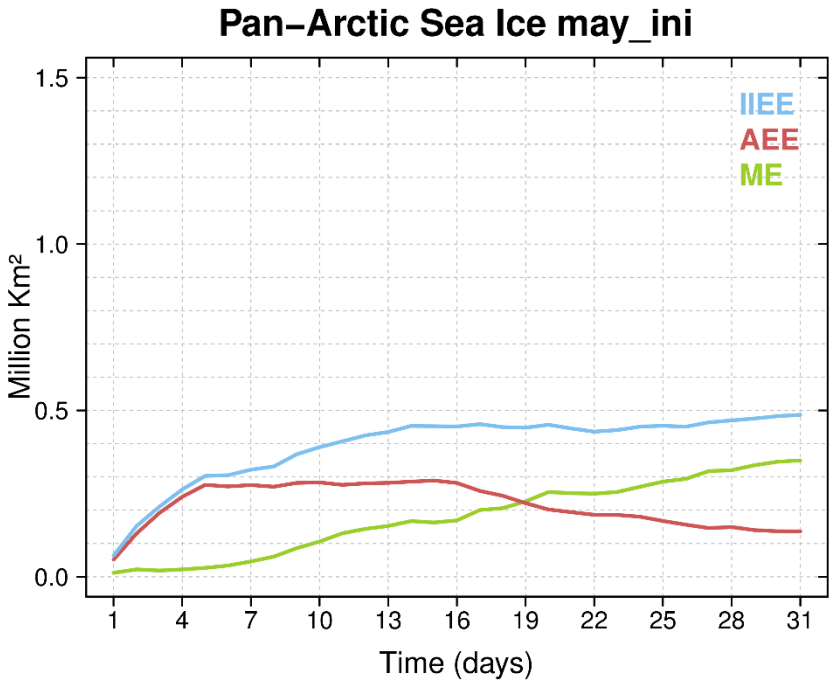
AEE = |O - U|

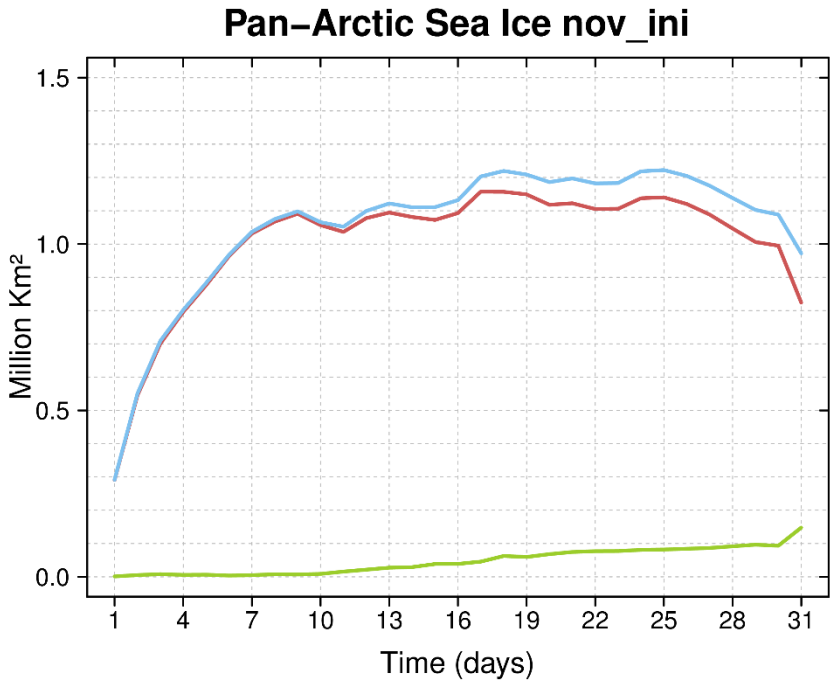
ME = 2 *min(O, U)

Goessling et al. (2016, GRL)

3. Understanding how model errors develop

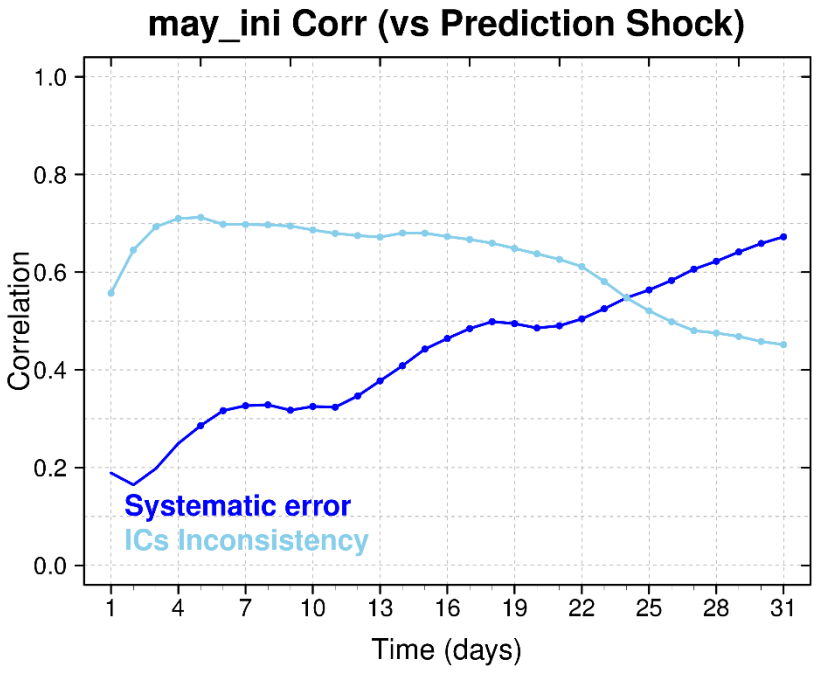
- At the beginning of the forecasts the IIEE is mostly AEE.
- Fast initial shock in November.
- ME gains importance with the forecast time (less in winter).

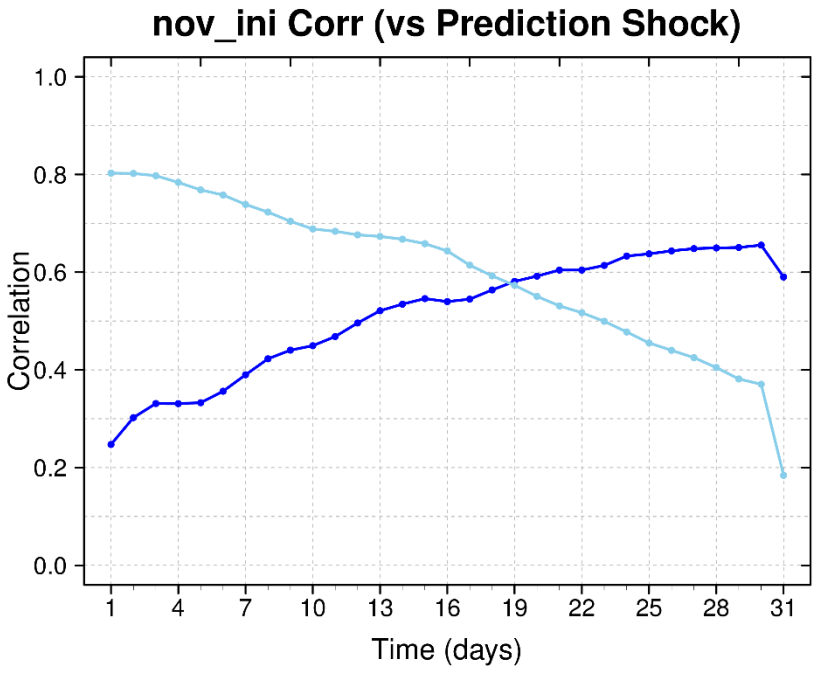




3. Understanding how model errors develop

- After 26 (21) days the systematic model error becomes the largest contributor to the forecast error in May (November).





Conclusions

- **Inconsistent initialization products may impact the predictions (**e.g. Mulholland et al. 2015, AMS**).**

- **The impact of initialization incompatibilities depends on the initialization date and the seasonality of the systematic error.**

- **The initialization shock dominates the forecast error the first ~20 days. After that, it is the systematic error the major contributor to the total forecast error.**

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Thank you

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